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FEDERAL COMMUNICATIONS COMMISSION
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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of

Review of Part 15 and other Parts
of the Commission's Rules

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ET Docket No. 01-278
RM-9375
RM-10051

To: The Commission

**COMMENTS OF ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO
IN RESPONSE TO NOTICE OF PROPOSED RULE MAKING**

**ARRL, THE NATIONAL ASSOCIATION
FOR AMATEUR RADIO**

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SUMMARY

ARRL, The National Association For Amateur Radio submits its comments in response to the Notice portion of the *Notice of Proposed Rule Making and Order* (the "Notice"), FCC 01-290, 66 Fed. Reg. 56793, released October 15, 2001. The Notice proposes, among other things, changes in the Commission's Part 15 rules governing unlicensed, periodic, intentional radiators so as to permit increased duty cycles and increased maximum permitted field strengths for radio frequency identification (RFID) systems at 433 MHz. The Amateur Radio Service wishes to avoid interference to extensive, and very sensitive Amateur Radio communications conducted daily in the 420-450 MHz band, especially around 433 MHz.

The Commission in this proceeding proposes a straightforward implementation of the Biennial Review recommendations. However, it has had two rulemaking petitions grafted onto it, which are unrelated to the remainder of the proceeding. The RFID rules proposed are flawed from their inception and should not be adopted under any circumstances. The Commission cannot legally proceed with the rules proposed for unlicensed RFID tags at 433 MHz. Nor is that frequency band a reasonable candidate band for such a use. The interference would preclude extensive, ongoing Amateur operation between 425-435 MHz, and the rules proposed would be contrary to a reasonable regulatory scheme for periodic radiator devices. The Commission should await cooperative efforts by other manufacturers working on a true global standard for RFID systems, and should look at other frequency bands for this use.

ARRL requests that the Commission not adopt the proposed rules regarding RFID systems at 433 MHz, but rather terminate this portion of the docket proceeding without action.

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ARRL, The National Association For Amateur Radio ("ARRL", also known as the American Radio Relay League, Incorporated), by counsel and pursuant to Section 1.415 of the Commission's Rules (47 C.F.R. §1.415) hereby respectfully submits its comments in response to the Notice portion of the *Notice of Proposed Rule Making and Order* (the "Notice"), FCC 01-290, 66 Fed. Reg. 56793, released October 15, 2001. The Notice proposes, among other things, changes in the Commission's Part 15 rules governing unlicensed, periodic, intentional radiators so as to permit increased duty cycles and increased maximum permitted field strengths for radio frequency identification (RFID) systems at 433 MHz. In the interests of the Amateur Radio Service in avoiding interference to extensive, and very sensitive Amateur Radio communications conducted daily in the 420-450 MHz band, and especially around 433 MHz, ARRL states as follows:

I. Introduction

1. The Commission has in this proceeding proposed a generally straightforward implementation of the Biennial Review recommendations. It is, in general, a sound effort by the

Commission's staff. However, it has had two rulemaking petitions grafted onto it, which are unrelated to the remainder of the proceeding. One of those is of grave concern to ARRL. The proceeding examines numerous rule sections in Parts 2, 15 and 18 of the Commission's Rules. At paragraph 1 of the Notice, the Commission states that one of its proposals is to "modify the rules for radio frequency identification systems to harmonize our rules with those in other parts of the world and to allow for improved operation." The bases for the proposed rule changes related to this are two petitions for rule making. The first, RM-9375, was filed by the National Council for Information Technology Standardization Technical Committee B10. It sought modification of Section 15.225 of the rules governing emissions in the 13.553-13.567 MHz band. The intent of the modified rules is to permit increased flexibility for Radio Frequency Identification (RFID) systems. ARRL has no concern with that proposal, and interposes no objection to it.

2. The other proposal, which would eviscerate Section 15.231 of the Commission's rules governing periodic radiators, is based on a Petition for Rule Making, RM-10051, filed by SAVI Technology, Inc. (SAVI). SAVI has developed an RFID system which it wishes to operate at a center frequency of 433.92 MHz, at power levels arguably permitted for certain classes of periodic radiators at that frequency by Section 15.231(a),¹ but at a duty cycle (per shipping container) of up to two minutes with only a ten-second off-time. The present rules [Section 15.231(e)] limit duty cycles for such devices to one second or less, and the silent period between transmissions must be at least 30 times the duration of the transmission, but in no case less than

¹ As will be discussed below, this power level is permitted for Section 15.231(a) control devices, but it is significantly higher than that permitted for Section 15.231(e) periodic radiators.

ten seconds.

3. ARRL strenuously opposed this Petition when SAVI filed it, but the instant Notice does not address *any* of ARRL's objections. It notes the filing of opposing comments, but in lieu of any substantive analysis of SAVI's proposal *or* the substantial interference concerns raised in the ARRL comments and reply comments (and in other comments in opposition to the petition), the Notice merely states summarily, at paragraph 26, that ARRL "claim[s] that operation under the proposed provisions could possibly (sic) result in interference to amateur radio operators",² and then, at paragraph 27, concludes:

We agree with SAVI that changes to Part 15 to allow more advanced RFID systems in the 433 MHz band would serve the public interest. Accordingly, we are proposing to create a new section that would allow operation of such devices in the 425-435 MHz band. We propose to allow a maximum field strength of 11,000 microvolts per meter measured at a distance of 3 meters using equipment with an average detector function. The maximum peak level permitted would be 110,000 microvolts per meter measured at a distance of 3 meters [peak emission limit].

What led the Commission to its conclusion that these devices should be permitted under these operating parameters, especially given the worst possible choice of frequency from an interference perspective, is unexplained.³

² This is an error. ARRL did not refer to "possibilities" of interference. It submitted an interference showing with its reply comments, and its comments, at page 8, stated that "the field strengths and duty cycles proposed by SAVI are completely unreasonable and would undoubtedly seriously disrupt Amateur communications in some of the most popular of the Amateur Service allocations."

³ Also unexplained is the fact that SAVI asked only for authority to operate at 433.92 MHz (the normal occupied bandwidth of which would be 433.05-434.79 MHz) but the Notice proposes to permit high-powered, high-duty cycle RFID devices to be operated throughout the band 425-435 MHz. The Notice proposal would encompass all of the band used for weak-signal communications, and as well segments used actively for Amateur Television.

II. The Commission is Without Jurisdiction to Permit These Devices to Operate on an Unlicensed Basis

4. ARRL argued in its comments in response to SAVI's petition, and will again demonstrate herein, that the choice of frequency in this case by SAVI is irrelevant to anything other than the cost of manufacturing components. It is without doubt the worst choice SAVI could make, and the Commission has failed to give this proposal adequate technical scrutiny. Furthermore, as will be shown below, the choice of band is contrary to the direction virtually all other manufacturers of RFID devices are taking, in terms of developing a global standard. Other manufacturers are working together to develop a global RFID standard. As will be shown, the Notice proposal is inconsistent with that effort.

5. However, it is unnecessary for the Commission to reach that issue. The Commission is without statutory jurisdiction to permit a device with such substantial interference potential without individual licensing of such devices. As ARRL has noted numerous times in the past, the Commission has jurisdictional limitations on its ability to liberalize Part 15 regulations. The Communications Act of 1934 is devoid of any authority to allow unlicensed devices with substantial interference potential; such devices must be licensed. The only authority granted to the Commission to permit unlicensed devices under the Act is with respect to radio control and citizen's radio service facilities, and certain aviation and maritime services. 47 U.S.C. §307(e),⁴ and to regulate the interference potential of RF devices by "reasonable regulation", 47 U.S.C.

⁴ The Telecommunications Act of 1996, Pub. L. 104-104, 110 Stat. 56, Feb. 8, 1996, amended Section 307(e) of the Communications Act of 1934 to add to those services which may by FCC rule operate without individual licenses the aviation radio service for aircraft stations operated on domestic flights when such aircraft are not otherwise required to carry a radio station; and the maritime radio service for ship stations navigated on domestic voyages when such ships are not otherwise required to carry a radio station.

§302, which does not affect its obligations under Section 301. In order to invoke Communications Act jurisdiction to amend the Part 15 rules as proposed, the Commission must make a specific finding that the devices operating under the parameters of the proposed new rules would not cause interference to licensed radio services. Absent such a finding, the devices can only be authorized on a licensed basis.

6. The Commission's Rules for the operation of Part 15 devices are generally appropriate for operation of devices which incidentally utilize RF energy in their operation, or which have such low radiated or conducted emission levels (or extremely short duty cycles) that interference is generally unlikely. However, the Commission does not have unfettered jurisdiction, pursuant to Section 302(a) of the Communications Act or otherwise, to authorize unlicensed devices without regard to the interference potential of those devices to licensed radio services. The issue is not whether the Commission has jurisdiction to enact reasonable regulations concerning RF devices. Rather, it is whether or not a device which has a substantial interference potential to licensed radio services must be *licensed*. The limit of the Commission's jurisdiction to permit the operation of RF devices without licenses is reached when it is concluded that the operation of such devices has a substantial interference potential to licensed services. To conclude otherwise, or to rely solely on the inadequate and unenforceable provisions of Section 15.5 of the Commission's rules for interference post-marketing, is in essence the abdication of the Commission's statutory licensing obligation, and its general obligation to manage the spectrum properly.

7. Section 301 of the Communications Act of 1934, as amended (47 U.S.C. §301) is quite clear as to the obligation of anyone who operates or uses an "apparatus for the transmission

of energy or communications or signals by radio...from one place in any State, Territory, or possession of the United States or in the District of Columbia to another place in the same State, Territory, possession or District;...or...within any State when the effects of such use extend beyond the borders of said State, or when interference is caused by such use or operation with the transmission of such energy, communications, or signals from within said State to any place beyond its borders, or from any place beyond its borders to any place within said State; or...upon any vessel or aircraft of the United States...or... upon any other mobile stations." No such apparatus can be used or operated "except under and in accordance with this chapter and with a license in that behalf granted under the provisions of this chapter."

8. There are no exemptions from this licensing requirement for devices which may cause interference to licensed radio services. However, the Communications Amendments Act of 1934, Public Law 97-259, provided for the elimination of issuance of individual licenses in the Citizens Radio Service, and in the Radio Control Service; and the Telecommunications Act of 1996, Pub. L. 104-104, 110 Stat. 56, Feb. 8, 1996, amended Section 307(e) of the Communications Act of 1934 to add to those services which may by FCC rule operate without individual licenses the aviation radio service for aircraft stations operated on domestic flights when such aircraft are not otherwise required to carry a radio station; and the maritime radio service for ship stations navigated on domestic voyages when such ships are not otherwise required to carry a radio station. There is, however, no general exemption from the licensing requirement for RF devices generally. The purpose of the licensing requirement in Section 301 of the Communications Act as a prerequisite to the use or operation of apparatus for the transmission of communications by radio is to prevent interference with radio communications. *Todisco v. United States*, 298 F. 2d

208 (9th Cir. 1961); *cert. denied*, 368 U.S. 989 (1961).

9. The rationale for allowing unlicensed RF devices under Part 15 is based on the assumption that such devices will not, in general, interfere with licensed radio services. The Commission's rules governing Part 15 unlicensed devices were established in approximately 1938, at which time the Commission "allowed devices employing relatively low level RF signals to be operated without the need for individual licensing *as long as their operation caused no harmful interference* to licensed services and the device did not generate emissions or field strength levels greater than a specified level." *Notice of Proposed Rule Making, Revision of Part 15 of the Rules Regarding the Operation of Radio Frequency Devices Without An Individual License*; FCC 87-300, 2 FCC Rcd. 6135 (1987); *First Report and Order*, 66 RR 2d 295, 298 (1989). The field strength limit applied to early Part 15 devices was *15 microvolts per meter* measured at a distance equivalent to the wavelength of the operating frequency divided by 2 Pi. As the frequency of these devices increased, and achieving that field strength level became more difficult, "over the years the Commission amended and expanded Part 15 of the rules to permit the non-licensed operation of devices at higher frequencies in those cases where it could be determined that the mass-marketing of such products would not result in harmful interference to authorized services." *Id.*, 2 FCC Rcd. at 6135.

10. The Commission's jurisdiction to permit unlicensed RF devices derives from the fact that they are configured so as not to result in harmful interference to licensed radio services, and can be authorized on that basis, but only on that basis. Section 302(a) of the Communications Act does not constitute an exception to the license requirements of Section 301. Instead, Section 302(a) was specifically enacted by Congress so that the Commission would have the authority

to regulate RF equipment at the manufacturer level, rather than (as was previously the case) at the user level, thus to *preclude* interference to licensed services. Congress recognized that aftermarket interference resolution was simply unworkable. Section 302(a) provides as follows:

The Commission may, consistent with the public interest, convenience and necessity, make reasonable regulations (1) governing the interference potential of devices which in their operation are capable of emitting radio frequency energy by radiation, conduction, or other means in sufficient degree to cause harmful interference to radio communications...

11. According to its legislative history, the purpose of this statute was not to enable the Commission to permit any unlicensed RF devices it chooses. Rather, Congress' intention was to "empower the Commission to deal with the interference problem at its root source -- the sale by some manufacturers of equipment and apparatus which do not comply with the Commission's Rules." *1968 U.S. Code Cong. & Admin. News*, p. 2486. In considering this legislation, Congress perceived a gap in the Commission's then-existing authority. Prior to the passage of Section 302(a), the Commission only had the power to "prohibit the use of equipment or apparatus which causes interference to radio communications." *Id.*, at p. 2487. In other words, it had no authority to control the interference potential of RF devices at the manufacturing level, but rather could only take action against an aftermarket user of equipment when an actual instance of harmful interference had occurred. *Id.*, at pp. 2487-8. In the view of the Senate, it was equitable to place the burden of equipment compliance on the manufacturer in the first instance as opposed to the user who would purchase the device assuming its operation to be legal. *Id.*, at 2487-8. Therefore, the Commission was expected to address the then-burgeoning problem of interference to licensed radio services by regulating the manufacturer of the device, rather than the user of the device in the field, whether or not the device was part of a licensed

radio service. It is obvious from this that Congress believed that aftermarket interference remedies to interference to licensed radio services from Part 15 devices were inadequate, and expected FCC to prevent interference *ab initio* by rules limiting manufacturers and retailers, not by enforcement. This expectation is explained in a June 25, 1965 letter from the Director of Telecommunications Management in the Office of the President to Senator Pastore, then Chairman of the Subcommittee on Communications of the Commerce Committee, stating in part as follows:

While the Commission takes the position, and I believe, properly, that the Communications Act prohibits the use of equipment or apparatus which causes interference to radio communications, it has no specific rulemaking authority under the act to require that before equipment or apparatus is put on the market it must be properly designed to prevent harmful interference. Since the prohibition falls on the use of the offending equipment, it means that the Commission, in trying to control radio interference, is confined to apprehending the users of equipment which in most cases has been purchased in good faith on the assumption that its operation would be legal. This after-the-fact approach is quite inadequate to control the "radiation smog" which makes it increasingly difficult for any user of radio communications to obtain interference-free reception.

Id., at 2497.

Furthermore, on June 9, 1965, the Commission's Chairman, E. William Henry, wrote to the Director, Consumer Products Division, Electronic Industries Association, concerning the proposed Section 302(a) legislation, explaining the intent of it as follows:

The purpose of the pending bills is to extend our authority and thereby permit the Commission to apply its regulations directly to the manufacture and sale of the equipment. Thus, the fundamental difference between the existing and the requested additional authority is to permit regulation of equipment capable of causing interference to radio reception before this equipment is sold to the public. Our criteria and considerations in evaluating the interference potential of such equipment will remain as they now are.

It should be clear that it is manifestly impossible to locate and correct each

individual piece of equipment producing interference, whereas it is reasonably feasible to regulate the manufacture and distribution of such equipment. Thus, it is our primary objective to require manufacturers and sellers to comply with the regulations which are now applicable only to the user.

Id., at 2497-8.

12. From a review of the legislative history of Section 302(a) of the Communications Act, it is apparent that there is no basis for viewing that Section as creating an exception to the licensing requirements of Section 301 of the Act. It is also clear that an after-market remedy applicable to users of Part 15 devices, such as Section 15.5, is an insufficient means of regulating interference. Indeed, it was exactly that finding that caused Section 302(a) to be enacted in the first place. When the Commission, pursuant to Section 302(a), evaluates proposed rules which would authorize *unlicensed* RF devices in certain configurations, it must reasonably conclude that the devices operating according to those parameters will not cause interference to licensed services. If it can't make that conclusion, the devices must, by statute, be operated on a licensed basis under some rule part other than Part 15. In this proceeding, and in other recent Commission proceedings,⁵ this statutory obligation has not been properly discharged. The Commission has no basis for concluding that RFID devices operating under the proposed parameters will not cause substantial interference to the Amateur Service. In fact, ARRL has demonstrated in this proceeding that substantial interference from these devices is inevitable. Therefore, the devices cannot be authorized as proposed.

III. Unlicensed RFID Devices at 433 MHz Will Cause

⁵ See, e.g. *Certification of Equipment in the 24.05-24.25 GHz Band at Field Strengths up to 1500 mV/m*, FCC 01-357, 67 Fed. Reg. 1623 (2002); *Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, FCC 97-5, released January 9, 1997.

Substantial Interference to Licensed Amateur Radio Operations and Cannot Be Permitted

13. The Notice, at paragraph 27, claims that the Commission has determined that peak RF levels of 110,000 uV/m at 3 meters premised on duty cycles of "periodic" radiators in the 425-435 MHz band of up to two minutes *per device*, "will provide an adequate signal for reliable communications while minimizing the potential for interference to other users of the band." There is no indication how the Commission arrived at that conclusion, or the basis for the conclusion that interference will be "minimized". ARRL suggests that the determination lacks technical support and is therefore arbitrary. An analysis based on normal operating parameters of the extensive Amateur uses in the band 425-435 MHz, reveals that unacceptable interference will result. This will preclude or repeatedly disrupt Amateur operation.

14. On January 14, 2002, ARRL made an *ex parte* presentation to the Office of Engineering and Technology staff. Attached as **Exhibit A** is a copy of the interference study presented to the staff at that time. It shows that in the 425-435 MHz band, there is extensive deployment of amateur television, packet data communications, weak-signal Earth-moon-Earth (EME) communications, and weak signal CW and mixed modes (principally SSB communications), propagation beacons, and auxiliary fixed links for repeater control. The heaviest use of this segment is for terrestrial, weak-signal communications. Virtually all of the commercially manufactured Amateur transceivers for VHF and UHF satellite and terrestrial weak signal operation include the 430-450 MHz band. Due to the wide availability of commercially-manufactured equipment for this band, it is heavily occupied with users in most parts of the country. The segment between 432 and 433 MHz is extremely heavily used every day for UHF terrestrial weak-signal operation, and the receivers and preamplifiers typically

deployed in this band are extremely sensitive.

15. The attached interference study concludes that, based on expected signal levels at various distances from a victim Amateur receiver, substantial interference to Amateur stations well in excess of 1,000 meters from the RFID system is expected. These devices will preclude Amateur EME or terrestrial weak-signal operation under the circumstances. While such devices operating at these power levels have the potential for interference under the current Section 15.231(e) regulations, it is possible for an Amateur station to adjust to bursts of interference from devices with a duty cycle of less than a second, with off-times at least 30 times the duration of the on-time. While the interference exists, it is possible to continue communications due to the short duty cycles and the long off-times. It is not possible for an Amateur station to adjust to interference lasting two minutes at a time per device. Furthermore, even the ten-second off-time is suspended where data packets are missing and retries are necessary. Thus, the devices must be considered to utilize 100 percent duty cycles. Factoring in essentially continuous interference from retransmissions and the aggregate interference from multiple devices, the interference is preclusive.⁶ Furthermore, the Commission's proposal to permit high signal levels

⁶ ARRL would commend to the Commission's attention the excellent comments previously filed in this proceeding by Mr. Fred C. Jensen, who states, in part:

While SAVI's filings will suggest that their system will only interrogate each tag infrequently, the typical application will be interrogating many tags in a yard or storage area. Giving SAVI (and any other such) devices the prerogative of essentially continuous transmission at field strengths permitted only for duty cycles of 1 second in 3,600 seconds can only be seen as a gross perversion of the Commission's long standing approach to unlicensed intentional radiators.

Further, in the case of an intermodal terminal such as Roseville, CA, the arrival of a container train (100 cars x 2 containers per car) would likely necessitate interrogating the contents of all 200 containers...at 2 minutes per container,

and duty cycles in this band reverses the respective regulatory posture of unlicensed versus licensed services. It makes the licensed service adjust its operation in response to the amount of interference it will receive from unlicensed devices.

16. The Notice, at paragraph 26, references SAVI's unsupported claims that RFID systems "typically" operate in "commercial" areas where there are few amateur operations. This is an absurd contention. United Parcel Service⁷ suggests that the value of this system is its ability to use the devices for package tracking, which would include its trucks. The fact is, RFID systems are ubiquitous, itinerant, and could operate in environments that often include Amateur stations. Furthermore, many residential areas abut commercial use areas, and geographic separation cannot in this instance be relied upon for interference mitigation. Furthermore, the reference in the same paragraph to the type of modulation used by the SAVI device (which SAVI mysteriously claims mitigates interference relative to Amateur stations) is irrelevant; the proposed rules specify no particular modulation scheme, and SAVI proposed no limits on modulation characteristics in its Petition. While it would appear that the Commission's intent is to make regulations not only device-specific but manufacturer-specific in this instance (for reasons unstated and unknown), its references to SAVI's modulation type would only be relevant if included as part of a comprehensive interference study provided by SAVI, which the record

something over 6.6 hours of continuous transmission, assuming perfect scheduling, no retransmissions, and no collisions. Thus, exempting retransmissions from the duty cycle limitation simply assures that the devices will be transmitting continuously.

⁷ The Notice cites favorable comments on the SAVI petition filed by United Parcel Service and Oracle. What neither of those comments revealed was that both companies are venture capital investors in SAVI, which goes a long way toward an explanation of the supporting comments filed in response to SAVI's petition.

lamentably lacks to date, and part of a comprehensive series of rules to reduce interference potential. The proposed rule, which as discussed above eviscerates the periodic radiator rules, is vague and overbroad, and would permit at unsuitable power levels and duty cycles any digital devices which "use radio frequency energy to locate and identify devices and exchange data."

17. While the proposed gutting of the duty cycle limitations of Section 15.231(e) is the worst portion of this ill-conceived proposal in terms of interference to Amateur stations, the substantial increase in maximum permitted field strengths is a major contributor as well. The Notice, at paragraph 27, claims that the proposed peak field strength of 110,000 uV/m is "the same as the current limit in Section 15.231(a) at 433 MHz...". However, Section 15.231(a) is applicable only to control transmissions, and continuous transmissions such as voice, video or data, are not permitted. Periodic transmissions for control purposes under Section 15.231(a)(3) are limited to not more than one second *per hour*. Continuous field strengths of 110 mV/m for these devices would provide reasonable communications at ranges well in excess of 1 km, even with insensitive receivers. Interference to sensitive amateur radio receivers, which in the 433 MHz band utilize extremely high gain antennas, is inevitable.

18. Viewed in terms of average field strength, the present Section 15.231 rules permit up to 4,400 uV/m, measured at 3 meters, at a frequency of 433.9 MHz. The proposed maximum average field strength of 11,000 uV/m is 2.5 times that value. There is absolutely no justification for that increase anywhere in the record in this proceeding.

IV. The Premise for Section 15.231(e) is Subverted By the Notice Proposal

19. Section 15.231 is premised on the concept that higher field strengths can be used by unlicensed Part 15 intentional radiators without causing interference to ongoing licensed

communications services if the duty cycles are extremely short. In this case, SAVI wants to have its cake and eat it too: it wants: (A) the high power levels so that its unlicensed devices can be used over long paths (100 yards); (B) long duty cycles so that the devices can transmit large amounts of data; (C) on a frequency band heavily used by a licensed radio service using sensitive receivers for EME and terrestrial communications; and (D) all of the above on an unlicensed basis. Part 15 generally, and Section 15.231(e) specifically, were never intended to address this type of use. As discussed above, Amateur Radio licensees can abide interference from a high-powered unlicensed periodic transmitter if the duty cycles of that transmitter are sufficiently short and the off-times sufficiently long so as to permit the communications to continue. The level of interference from the devices permitted under the proposed rule is intolerable.

20. Existing periodic emitters function reasonably well within the existing provisions of Section 15.231(a) and 15.231(e). Neither section, however, was intended to accommodate long, continuous periods of transmissions approaching 120 seconds, with but a 10-second off-time, at 110,000 uV/m measured at 3 meters. The existing provisions of Section 15.231 serve adequately for a communications range of 100 meters. If SAVI's device cannot use modulation and encoding techniques that would allow it to get data throughput it needs in order to communicate 128 kilobytes of data in a reasonable time, SAVI should manufacture equipment under the several other sections of Part 15 that do not have the limits the Commission intended for periodic radiators. The 902-928 MHz or 2400-2483.5 MHz bands are likely candidates, but as seen below, SAVI and the Commission should pay attention to the efforts made by other manufacturers to specify bands and standards which have a chance at global acceptance.

Continuous duty, high power devices were never envisioned in Section 15.231, and the Commission's proposal to eviscerate the periodic radiator rules is in this case baseless.

**V. The Only Basis for Proposed Use of 433 MHz by SAVI
is to Reduce Hardware Costs**

21. There is no technical basis for the use of the 433 MHz band, as opposed to any other band, for RFID tags. The Commission *cannot* conclude that the use of 433 MHz for RFID tags at the parameters proposed is in the public interest because the interference potential is not offset by any need or justification for the use of that frequency. As ARRL noted in comments in response to SAVI's Petition for Rule Making (and a point which the Notice ignored completely), the only reason SAVI chose the frequency 433.9 MHz for its devices is because of the availability of relatively cheap components, due to the fact that the band 433.05-434.79 MHz (center frequency 433.92 MHz) is available for ISM uses in Germany, Austria, Bosnia/Herzegovina, Croatia, Macedonia, Liechtenstein, Portugal, Slovenia, Switzerland and Yugoslavia according to the International Table of Allocations. The frequency choice has absolutely no technical justification whatsoever, and any contention by SAVI to the contrary is a misrepresentation. An article in American Shipper Magazine for December, 2001 concerning SAVI quotes a Defense Department program manager as follows:

Asked if SAVI could adapt its RF tags for the private sector, Waddick said "they've apparently made a start in that direction. The price would have to come down per unit."

According to a representative of a strategic enterprise fund of United Parcel Service, quoted in the same article:

"As the price comes down, radio frequency tags could make economic sense to us to use throughout our delivery network", Wilson said. "That could have major

implications for the way we do business and the services we offer."

The price of the tags is a problem for SAVI, and the choice of frequency band is related only to the cost of components. That commercial issue is not a justification for the Commission to subject the Amateur Service to the inevitable interference from these devices, and it does not justify the Commission's violation of Section 301 of the Communications Act.

VI. Global Standardization for RFID Will Not Be Achieved At 433 MHz

22. That the SAVI system as configured, and as the Notice has proposed, is unnecessary as a technical matter is readily apparent in light of recent RFID developments of other companies. The premise of SAVI is that it intends to implement a global standard for RFID technology. It is not going to do this in the 433 MHz band, due to varying allocations of that band in other countries. ARRL noted in comments in response to SAVI's petition that many countries will not be able to utilize a 425-435 MHz RFID system due to conflicting allocations. As an example, the band 433.05-434.79 MHz, formerly available for "vehicle radio keys only" in the United Kingdom, is now available for other uses, including airborne telemetry based on 25 kHz channel spacing. The U.K. also imposed a 10% duty cycle for all new designs of equipment introduced on or after April 19, 1999. Existing designs of equipment with a higher duty cycle could continue to be sold, but only until December 31, 2005. After that date, all equipment in that band must comply with the 10% duty cycle requirement. That 10% duty cycle requirement comes from a CEPT recommendation, the policy of which requires shorter duty cycles in the near future.

23. Recognizing this, companies including Texas Instruments, Inc., Philips Semiconductors and Intermec Corp. are reportedly pursuing RFID technology in bands other

than 433 MHz. If the goal is to have RFID tags able to be read globally, a different technology is going to have to be deployed, or at least different frequency bands. The difficulty is in creating a global standard on which manufacturers in Europe, Asia and North America can agree. In the United States, Boeing, Federal Express and others are involved in creating RFID standards, along with the Department of Defense. According to a recent article in EE Times, an Engineering and Technical Management online news service which bears extensive quotation (<http://www.eet.com/story/OEG200111150065>):

"The challenge is to write a standard that everyone will agree on," said Michael Guillory, director of industry relations, systems and solutions for Intermec (Dallas), a major manufacturer of automated detection equipment. "When you bring in people from 20 countries, they will all naturally try to represent their own best interests."

The use of UHF would represent a dramatic departure from the RFID status quo. Up to now, the vast majority of such systems have employed data transmissions across lower frequencies, typically 125 kHz or 13 MHz...

The industry's newfound interest in UHF stems from the emergence of silicon transceiver chips capable of operating in the 300 MHz to 1 GHz UHF spectrum. Today, such chips are being supplied for RFID applications by only two semiconductor makers, TI and Philips Semiconductors, but that number is expected to grow if the worldwide supply chain community can agree on a standard.

"Silicon functionality at 900 MHz is relatively new," [Anthony] Sabetti [global business manager for RFID systems at TI, Plano, TX] said. "It's really just been in the past couple of years that it has gained wider acceptance."

SCS Corp. employs a 0.7-micron CMOS process for its chips, which are mounted on a conductive epoxy substrate that contains a screen-printed silver antenna. The chips contain simple microcontrollers capable of understanding 44 commands and storing about 1,000 bits of data. They are designed to send and receive data at frequencies of 915 MHz or at 2.45 GHz. Engineers from SCS say that they can keep smart tag prices as low as 50 cents apiece by employing a proprietary interface that enables a single chip design to operate in a frequency spectrum that begins at 5 MHz and extends all the way up to 15 GHz. The company is saying little about the proprietary aspects of the design, except that its products always

modulate the carrier signal in the megahertz range. "The chip looks at a signal envelope, rather than a single frequency," said Roesner of SCS. "So we can use the same chip for any carrier frequency between 5 MHz and 15 GHz."

The main obstacle lying in the path of UHF is a prominent one, however. Many supply chain managers don't want to invest time and effort in the technology if it can't be used globally. Right now, however, international conflicts loom on the horizon regarding the use of UHF frequencies. European companies want to use a frequency of 868 MHz to prevent incompatibility with GSM cell phones, while North America prefers 915 MHz. Worse, UHF frequencies are unavailable for use within Japan. "Because the regulations are not aligned, it's posing some challenges to writing a standard," said Intermec's Guillory. Experts say that the only solution is to develop tags that operate at both the North American and European frequencies. "There's no reason that a tag which operates at 868 MHz can't operate at 915 MHz," Guillory said. This is an obstacle, but it's not an insurmountable problem.

One hopeful sign, engineers say, is the emergence of the Global Tag, or GTAG, Initiative as a supporter of the UHF standardization efforts. The initiative, formed in March, 2000, is said to be pulling together support from various firms within the supply chain, as well as from the technology developers.

24. This extensive review of the state of RFID tag technology establishes several things. First of all, the Notice proposal is premature in the extreme. There is no indication that anyone except SAVI and its own venture capital investors are interested in 433 MHz. In fact, the choice of 433 MHz as an operating frequency is exactly contrary to a large-scale effort to arrive at a global industry standard, which is ongoing. This justifies an international study of the issue. In fact, there are draft recommendations now under consideration in Radiocommunication Study Group 1 (see, e.g. Draft New Recommendation ITU-R SM.[doc. 1/19]) which addresses *Technical and Operating Parameters and Spectrum Requirements for Short-Range Radiocommunication Devices*. There are, therefore, ongoing activities within the ITU intended to address spectrum and technical operating parameters for RFID systems. This proceeding is not within the mainstream of planning for a global standard for RFID systems. The United States

is clearly not in a position to unilaterally dictate this standard, and the Commission is headed in the wrong direction. SAVI should seriously consider the frequencies around 868 or 915 MHz, which apparently stand at least some reasonable chance of global standardization. It is noted, however, that the first global ISM band above 432 MHz is 2400-2500 MHz (See Footnote S5.150 to the Table of Allocations).

25. Second, SAVI, being concerned about the cost of RFID tags, might consider the effect of a global standard on the cost of individual tags, which is an issue of obvious concern to other manufacturers as well. No other RFID manufacturer of which ARRL is aware after diligent research, is advocating use of the 433 MHz band. ARRL is, however, aware of manufacturers of other Part 15 periodic radiators in that general frequency range, such as garage-door openers, which are currently being successfully marketed and operated under the present Section 15.231 (apparently without significant interference to the Amateur Service due to compliance with the duty cycle limitations in the current rules) who are quite reasonably concerned about interference from high duty cycle RFID devices to their own products.

VII. Conclusions

26. What the Commission has done in this proceeding is to propose a generally straightforward implementation of the biennial review recommendations. It is, in general, a sound effort by the Commission's staff. However, it has had two rulemaking petitions grafted onto it, which are unrelated to the remainder of the proceeding. The RFID rules proposed in response to the SAVI petition are flawed from their inception and should not be adopted under any circumstances. The Commission cannot legally proceed with the rules proposed for unlicensed RFID tags at 433 MHz. Nor is that frequency band a reasonable candidate band for

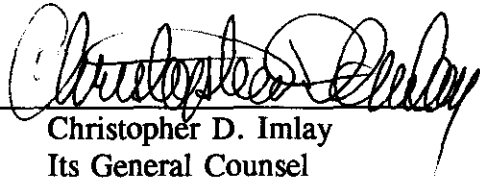
such a use. The interference would preclude extensive, ongoing Amateur operation between 425-435 MHz, and the rules proposed would be contrary to a reasonable regulatory scheme for periodic radiator devices. The Commission should await cooperative efforts by other manufacturers working on a true global standard for RFID systems, and should look at other frequency bands for this use.

Therefore, the foregoing considered, ARRL, the National Association for Amateur Radio, respectfully requests that the Commission not adopt the proposed rules regarding RFID systems at 433 MHz, but rather terminate this portion of the docket proceeding without action.

Respectfully submitted,

**ARRL, THE NATIONAL ASSOCIATION
FOR AMATEUR RADIO**

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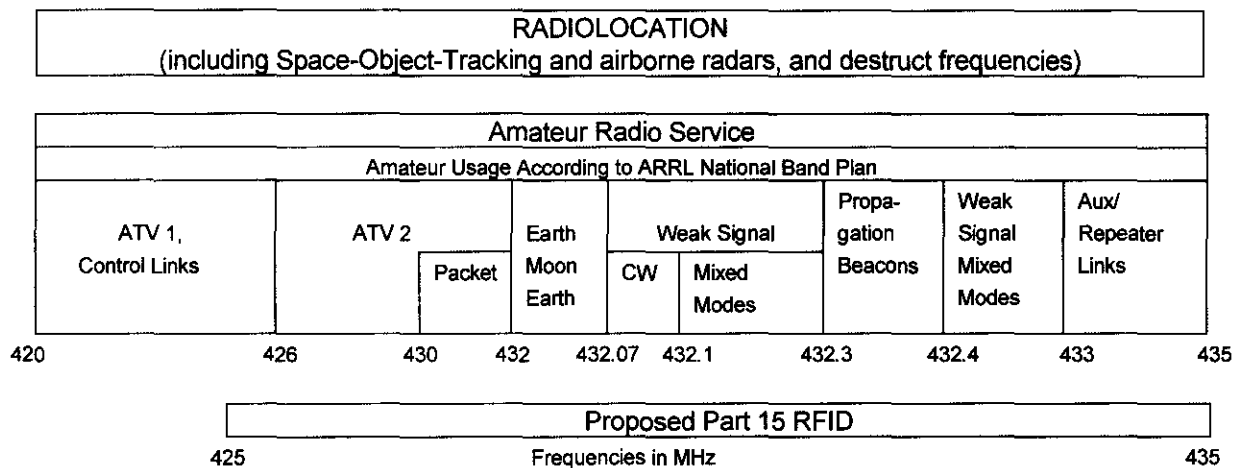
February 12, 2002

EXHIBIT A

**ARRL Ex Parte Presentation¹
to the Office of Engineering and Technology
Federal Communications Commission
January 14, 2002**

ARRL, the National Association for Amateur Radio, is seriously concerned that the Commission has proposed, in its *Notice of Proposed Rule Making and Order*, FCC 01-290, released October 15, 2001, to permit Radio Frequency Identification (RFID) systems to operate in the 425-435 MHz band. Therein, the Commission proposes to permit "periodic" radiators to operate in this band at peak field strengths of up to 110,000 $\mu\text{V/m}$ measured at a distance of 3 meters, and continuous levels of up to 11,000 $\mu\text{V/m}$.

The 420-450 MHz band is allocated to Government radiolocation on a primary basis and to the Amateur Radio Service on a secondary basis, a sharing arrangement that has worked well. The following frequency chart illustrates current usage and the proposed RFID overlay:



This band is an extremely poor choice for these devices, due to the substantial interference potential to a large number of amateur stations operating in the band, especially at 432-433 MHz, for terrestrial weak-signal communications.

While ARRL has no objection to the operation of these devices at the proposed operating parameters in a different band, there is no reason whatsoever why the 425-435 MHz band should be considered for these high-duty-cycle devices, rather than another band already available for high powered Part 15 devices, where amateur weak-signal communications are not actively conducted.

The attached interference study, prepared by the ARRL Laboratory, establishes that the signal levels proposed for RFID systems at the duty cycles proposed to be permitted in this proceeding will cause substantial interference to amateur stations in excess of 1,000 meters from the RFID transmitter. The analysis of the interference potential to amateur stations was based on the typical RFID system described by Savi Technology in its ex parte presentation of April 12, 2001 (re: ET Docket 01-278).

¹ Presentation by ARRL General Counsel Christopher Imlay and Technical Relations Manager Paul Rinaldo. Laboratory study was prepared by Laboratory Supervisor Ed Hare and Senior Engineer Zack Lau.

Expected Signal Levels:

The following graphs show the expected signal levels at various distances from signal sources that have a field strength of $110,000 \mu\text{V/m}$ at 3 meters and $11,000 \mu\text{V/m}$ at 3 meters. These levels are shown for receive antennas of various gains. These antenna gains were chosen to be close to the antenna gain typically used in various amateur station configurations. These levels represent the peak and non-peak signal strength described in the NPRM.

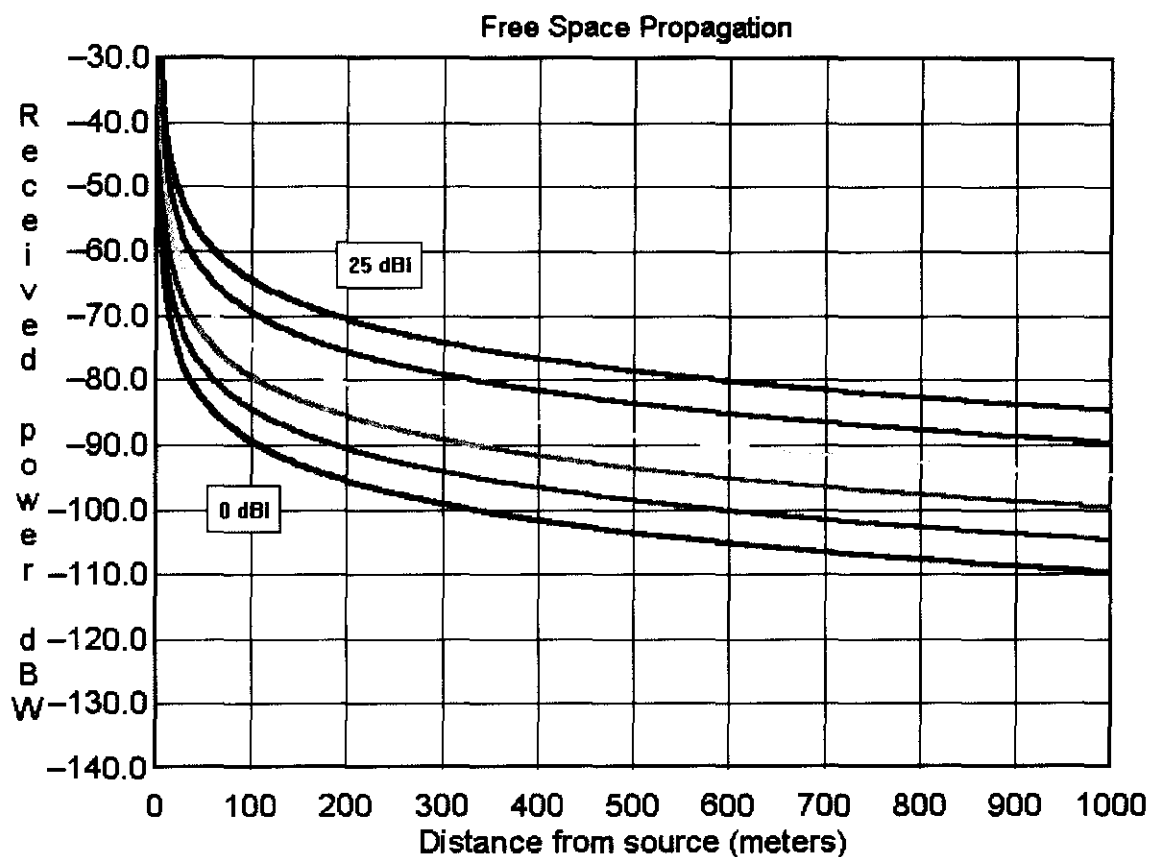


Figure 1: This graph shows the signal levels that will be delivered by a matched antenna with various gains on 433.92 MHz when it is placed at the specified distance from a field of $110,000 \mu\text{V/m}$. This represents the maximum peak level proposed in ET 01-278. Free-space propagation is assumed.

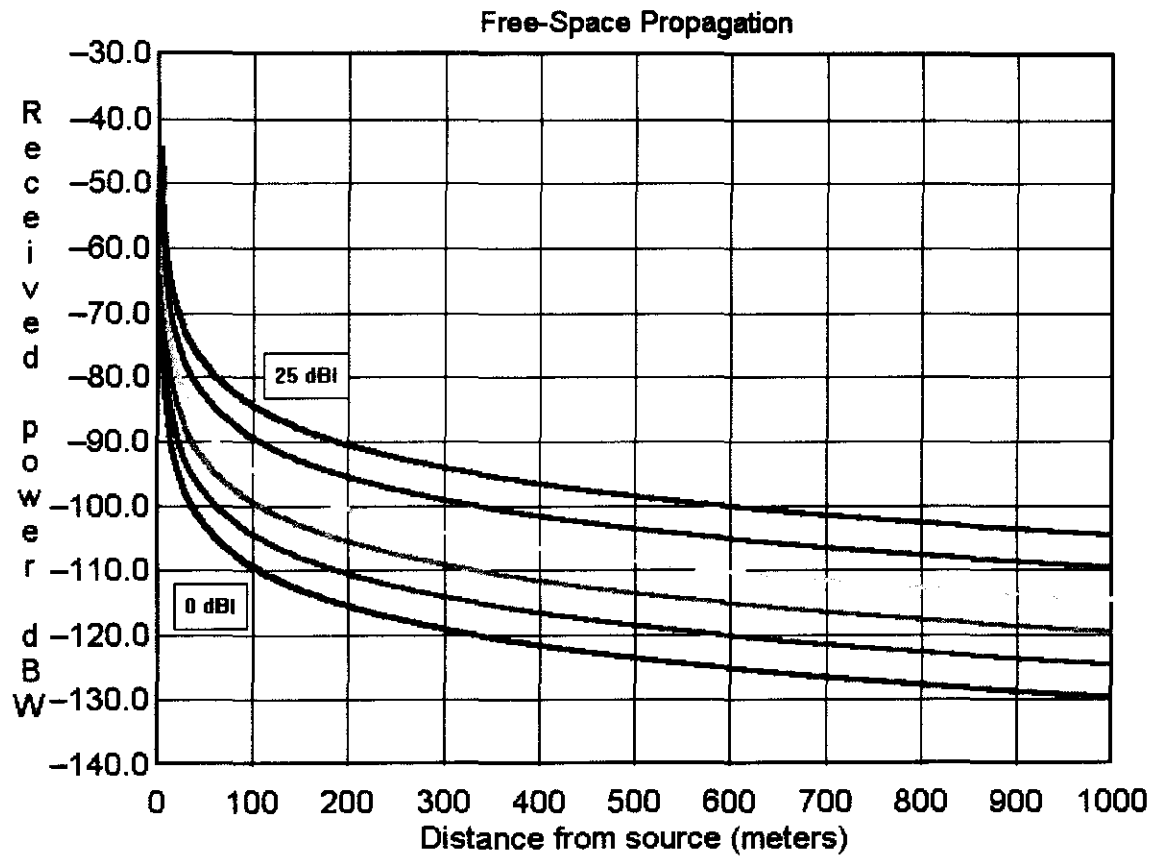


Figure 2: This graph shows the signal levels that will be delivered by a matched antenna with various gains on 433.92 MHz when it is placed at the specified distance from a field of 11,000 $\mu\text{V/m}$. This represents the non-peak, near-continuous level proposed in ET 01-278. Free-space propagation is assumed.

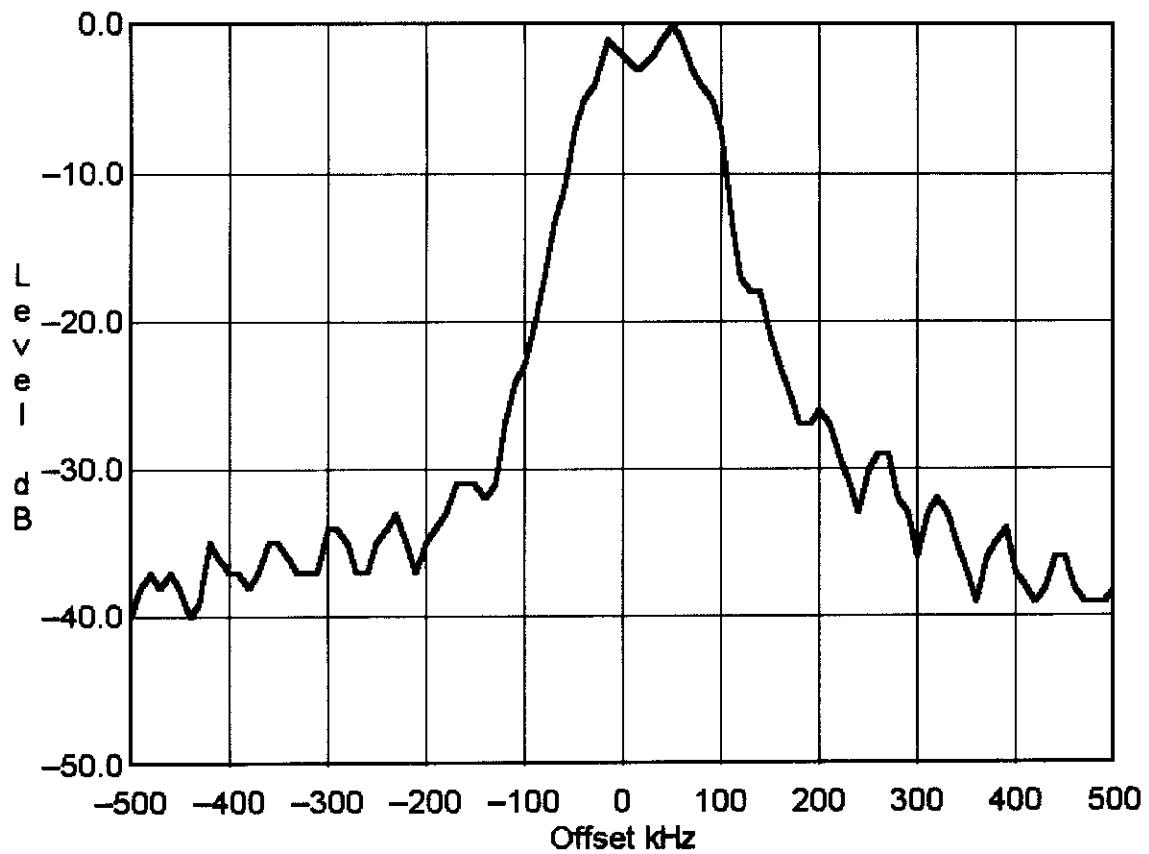


Figure 3: This is the typical occupied bandwidth of a SaviReader transmitter. (This is from Figure 1 from the ex parte presentation Savi made on April 12, 2001.) The -6 dB bandwidth is 140 kHz. The -26 dB bandwidth is 290 kHz.

Effect of RFID Signal on Specific Amateur Stations:

The following tables describe the operating parameters of amateur stations using different, typical operating modes. These modes and station configurations are by no means all inclusive. It should be noted that although most of the UHF RFID systems being proposed in conjunction with this rulemaking operate on 433.92 MHz, the rule-making procedure stipulates a frequency range of 425 to 435 MHz. The higher levels shown on these graphs represent the fundamental RFID signal, which, under the rules, could appear anywhere within that frequency range.

Typical FM Voice Amateur Station

The typical FM voice amateur station can communicate with other FM voice amateur stations using line-of sight and diffraction propagation modes.

Characteristics	Values
Frequency Band (MHz)	420-450MHz
Channel Spacing	Random, usually in 5-kHz steps
Information Rate	Speech
Emission Type(s)	15K0F3E or 15K0G3E
Transmitter Power (dBW)	14.0
Transmission Line Loss (dB)	3
Antenna Polarization	V
Antenna Maximum Gain (dBi)	5
Maximum e.i.r.p. (dBW)	16
Receiver IF Bandwidth	15 kHz
Receiver Noise Figure (dB)	2
Receiver Thermal Noise (dBW)	-157
Receiver Thermal Noise (dBm)	-127
Receiver Signal-to-Noise Ratio (dB)	+7 (for 12 dB SINAD)
Availability Target %	99
Maximum Path Length (km)	Depends on the propagation mode

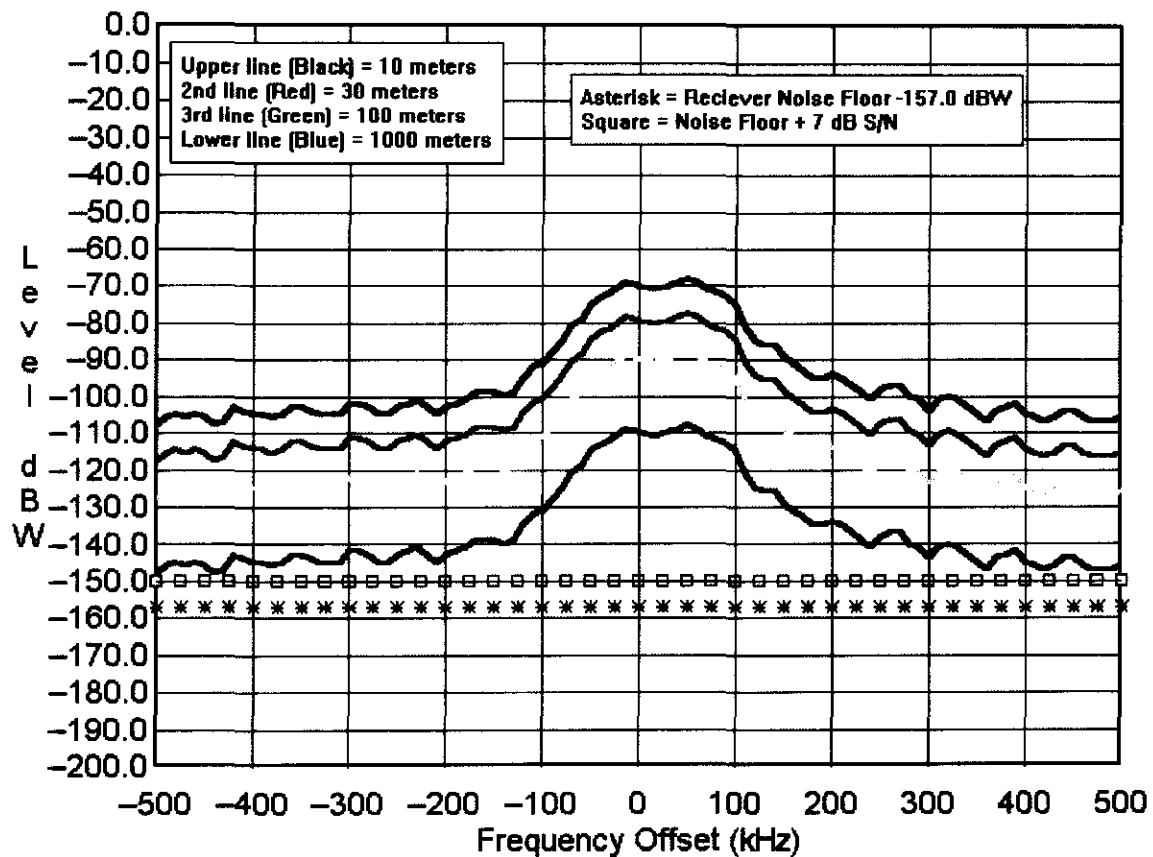


Figure 4. These data show the expected RFID system levels from the typical RFID transmitter generating 11,000 $\mu\text{V/m}$ at 3 meters. The amateur station is an FM receiving station using a 5-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 11,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 3 dB to account for the receive system bandwidth of 15 kHz. This amateur station typically has about -157 dBW of receiver sensitivity and a signal margin of approximately 7 dB for minimal communication.

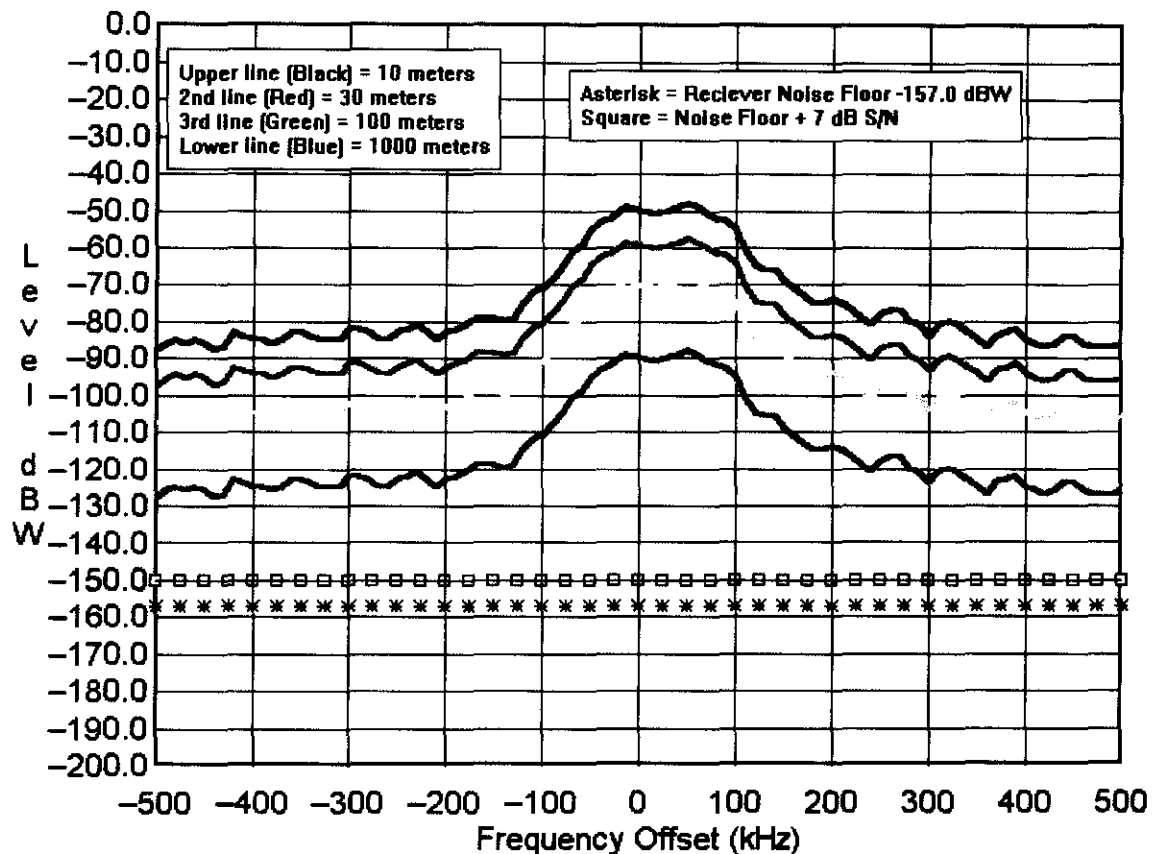


Figure 5. These data show the expected RFID system levels from the typical RFID transmitter generating $110,000 \mu\text{V/m}$ at 3 meters. The amateur station is an FM receiving station using a 5-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is $110,000 \mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 3 dB to account for the receive system bandwidth of 15 kHz. This amateur station typically has -157 dBW of receiver sensitivity and a signal margin of approximately 7 dB for minimal communication.

Typical FM Voice Amateur Repeater Station

The typical FM voice amateur repeater station can communicate with other FM voice amateur stations using line-of-sight and diffraction propagation modes.

Characteristics	Values
Frequency Band (MHz)	420-431MHz, 433-435MHz, 438-450 MHz
Channel Spacing	25 kHz
Information Rate	Speech
Emission Type(s)	15K0F3E or 15K0G3E
Transmitter Power (dBW)	15
Transmission Line Loss (dB)	3
Antenna Polarization	V
Antenna Maximum Gain (dBi)	5 (300 m height above average terrain)
Maximum e.i.r.p. (dBW)	17
Receiver IF Bandwidth	15 kHz
Receiver Noise Figure (dB)	2
Receiver Thermal Noise (dBW)	-157.9
Receiver Thermal Noise (dBm)	-127.9
Receiver Signal-to-Noise Ratio (dB)	+7 (for 12 dB SINAD)
Availability Target %	99
Maximum Path Length (km)	Depends on the propagation mode

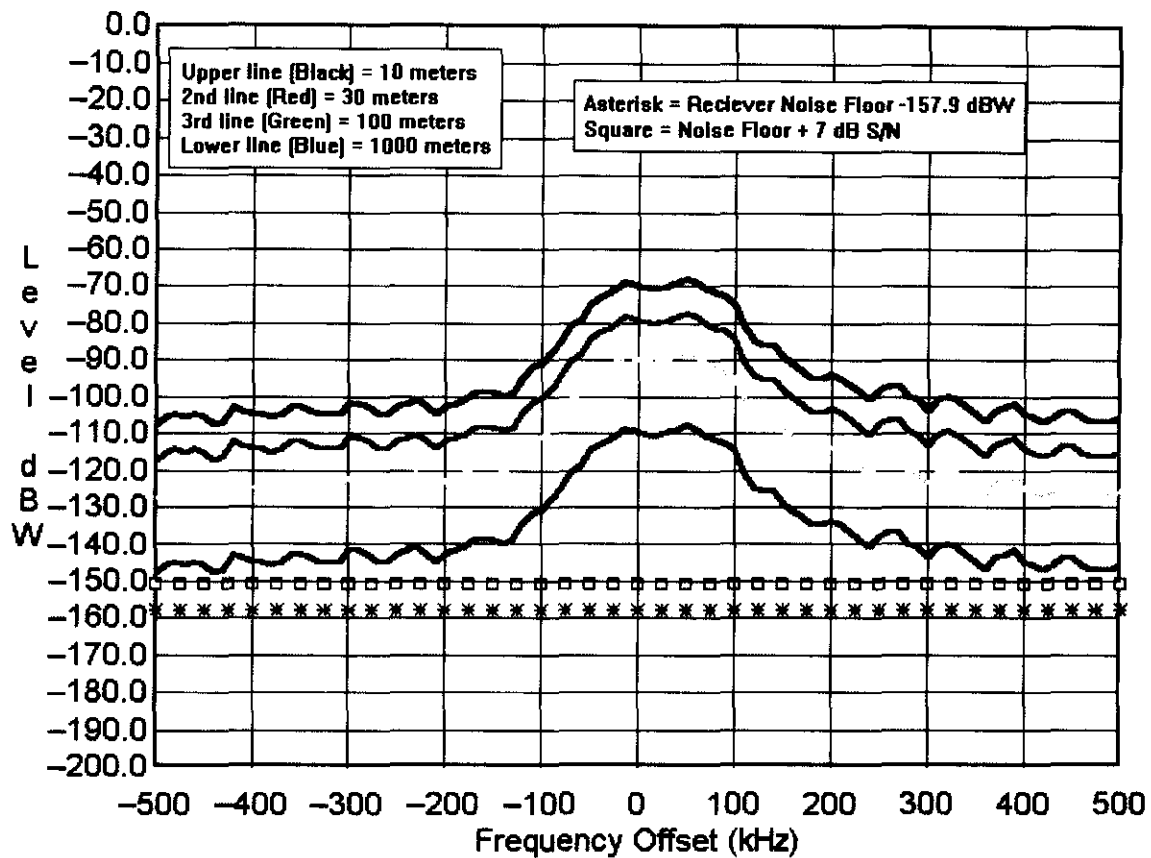


Figure 6. These data show the expected RFID system levels from the typical RFID transmitter generating 11,000 $\mu\text{V/m}$ at 3 meters. The amateur station is an FM repeater receiving station using a 5-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 11,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 3 dB to account for the receive system bandwidth of 15 kHz. This amateur station typically has -157.9 dBW of receiver sensitivity and a signal margin of approximately 7 dB for minimal communication.

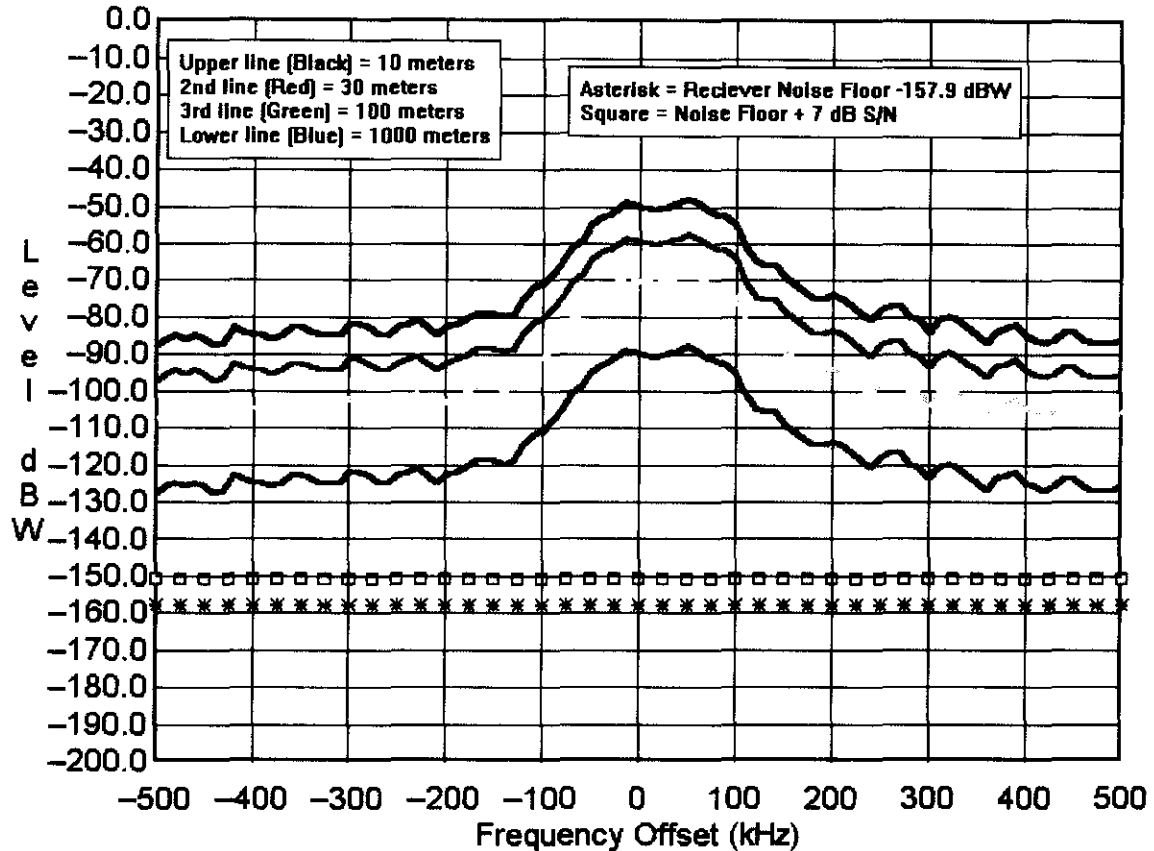


Figure 7. These data show the expected RFID system levels from the typical RFID transmitter generating 110,000 $\mu\text{V/m}$ at 3 meters. The amateur station is an FM repeater receiving station using a 5-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 110,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 3 dB to account for the receive system bandwidth of 15 kHz. This amateur station typically has -157.9 dBW of receiver sensitivity and a signal margin of approximately 7 dB for minimal communication.

Typical SSB Amateur Station

The typical SSB amateur station can communicate with other SSB stations at maximum ranges using any propagation mode available at the time.

Characteristics	Values	
Frequency Band (MHz)	420-450	
Channel Spacing	Random	
Information Rate	Speech	
Emission Type(s)	2K50J3E	
Transmitter Power (dBW)	20.0	
Transmission Line Loss (dB)	Transmit: 2	Receive: 0
Antenna Polarization	H	
Antenna Maximum Gain (dBi)	17.9	
Maximum e.i.r.p. (dBW)	35.9	
Receiver IF Bandwidth	2.5 kHz	
Receiver Noise Figure (dB)	1	
Receiver Thermal Noise (dBW)	-171.0 (155 K background)	
Receiver Thermal Noise (dBm)	-141.0 (155 K background)	
Receiver Signal-to-Noise Ratio (dB)	+6	
Availability Target %	99	
Maximum Path Length (km)	Depends on the propagation mode	

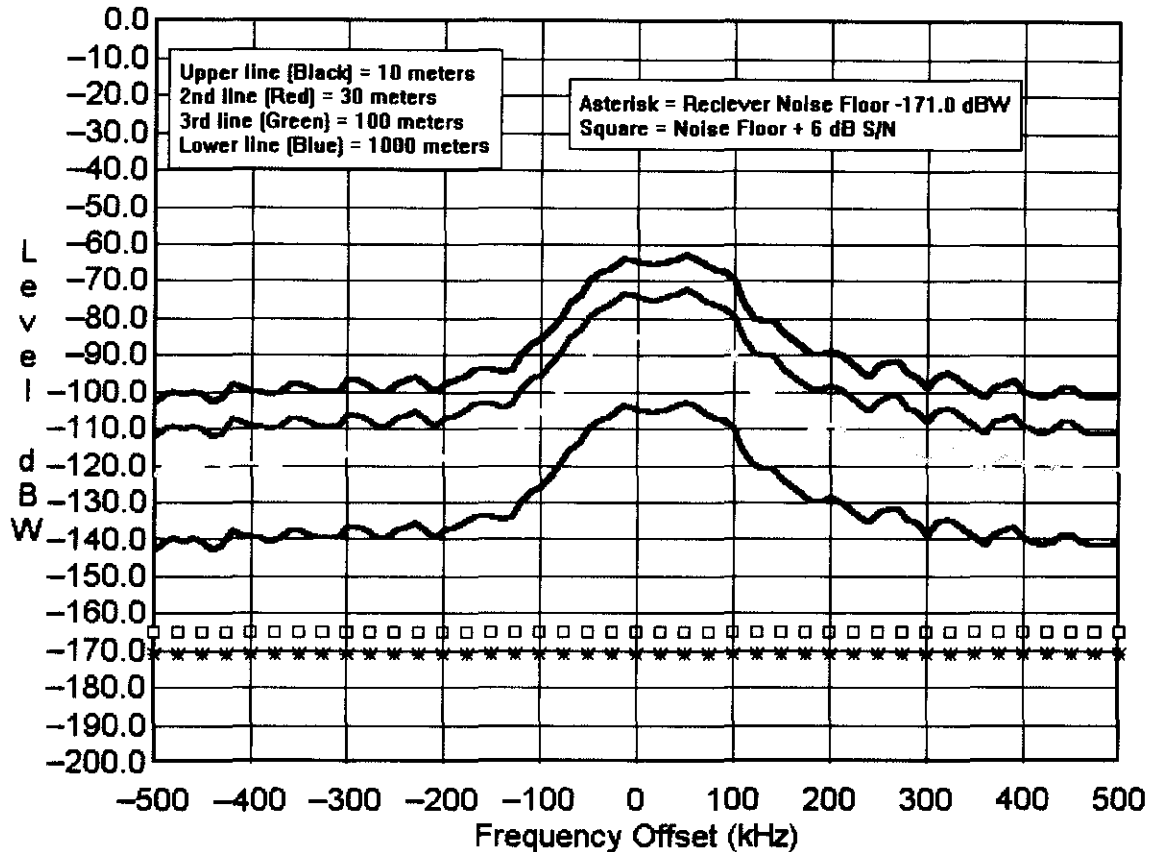


Figure 8. These data show the expected RFID system levels from the typical RFID transmitter generating 11,000 $\mu\text{V/m}$ at 3 meters. The amateur station is an SSB terrestrial receiving station using a 17.9-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 11,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 10.8 dB to account for the receive system bandwidth of 2.5 kHz. This Amateur station typically has about -171.0 dBW of receiver sensitivity and a signal margin of approximately 6 dB for minimal communication.

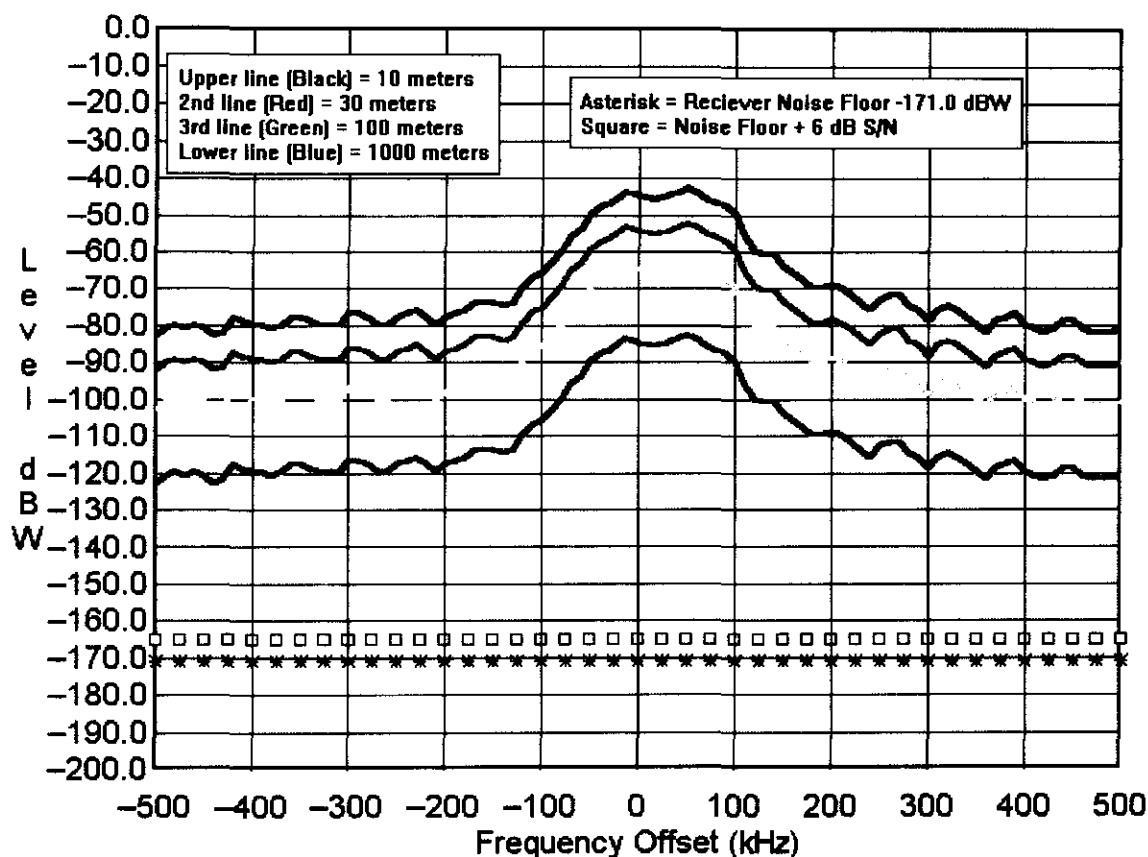


Figure 9. These data show the expected RFID system levels from the typical RFID transmitter generating 110,000 $\mu\text{V/m}$ at 3 meters. The amateur station is an SSB terrestrial receiving station using a 17.9-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 110,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 10.8 dB to account for the receive system bandwidth of 2.5 kHz. This Amateur station typically has about -171.0 dBW of receiver sensitivity and a signal margin of approximately 6 dB for minimal communication.

Typical CW Amateur Station

The typical CW amateur station can communicate with other CW stations at maximum ranges using any propagation mode available at the time.

Characteristics	Values	
Frequency Band (MHz)	420-450	
Channel Spacing	Random	
Information Rate	CW: 10 bit/s	
Emission Type(s)	100HA1A	
Transmitter Power (dBW)	20.0	
Transmission Line Loss (dB)	Transmit: 2	Receive: 0
Antenna Polarization	Horizontal	
Antenna Maximum Gain (dBi)	17.9	
Maximum e.i.r.p. (dBW)	35.9	
Receiver IF Bandwidth	100 Hz	
Receiver Noise Figure (dB)	0.5	
Receiver Thermal Noise (dBW)	-185.8	
Receiver Thermal Noise (dBm)	-155.8	
Receiver Signal-to-Noise Ratio (dB)	+1	
Availability Target %	99	
Maximum Path Length (km)	Depends on the propagation mode	

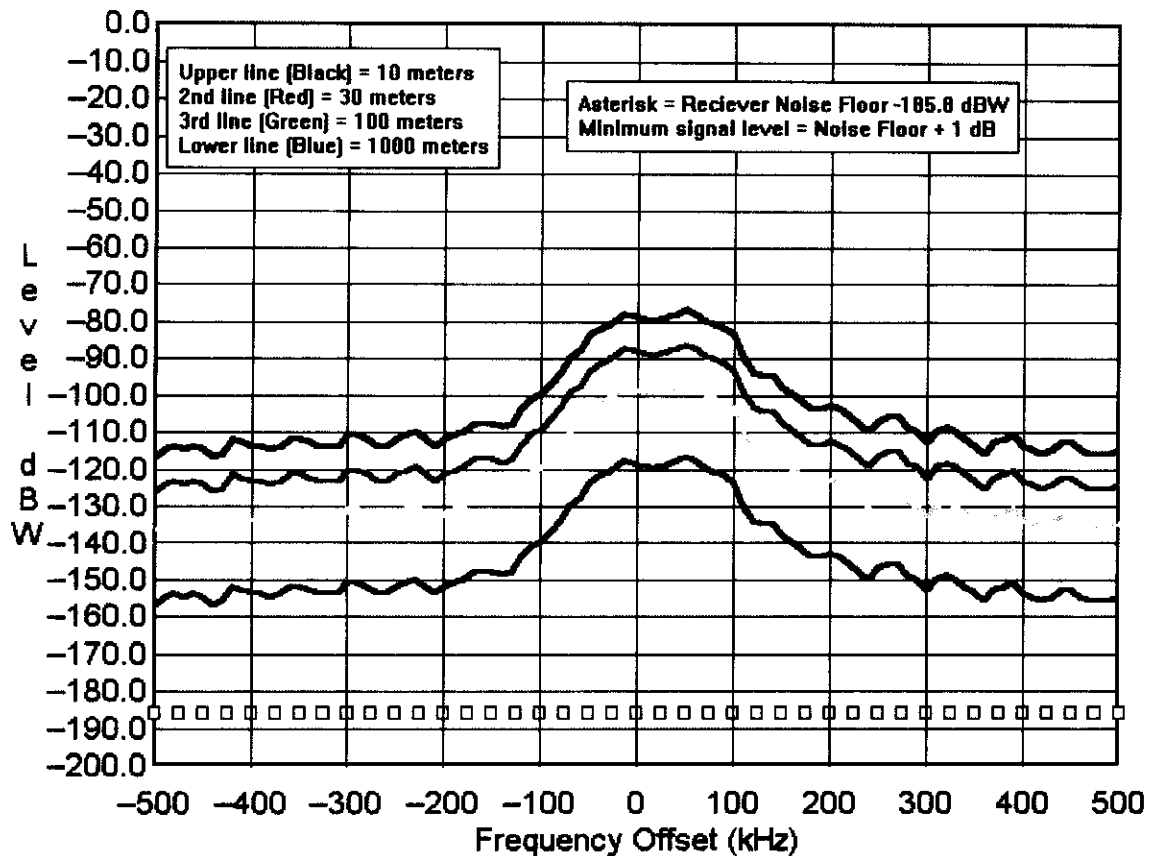


Figure 10. These data show the expected RFID system levels from the typical RFID transmitter generating 11,000 $\mu\text{V/m}$ at 3 meters. The amateur station is a CW terrestrial receiving station using a 17.9-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 11,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 24.8 dB to account for the receive system bandwidth of 0.1 kHz. This amateur station typically has about -185.8 dBW of receiver sensitivity and a signal margin of approximately 1 dB for minimal communication.

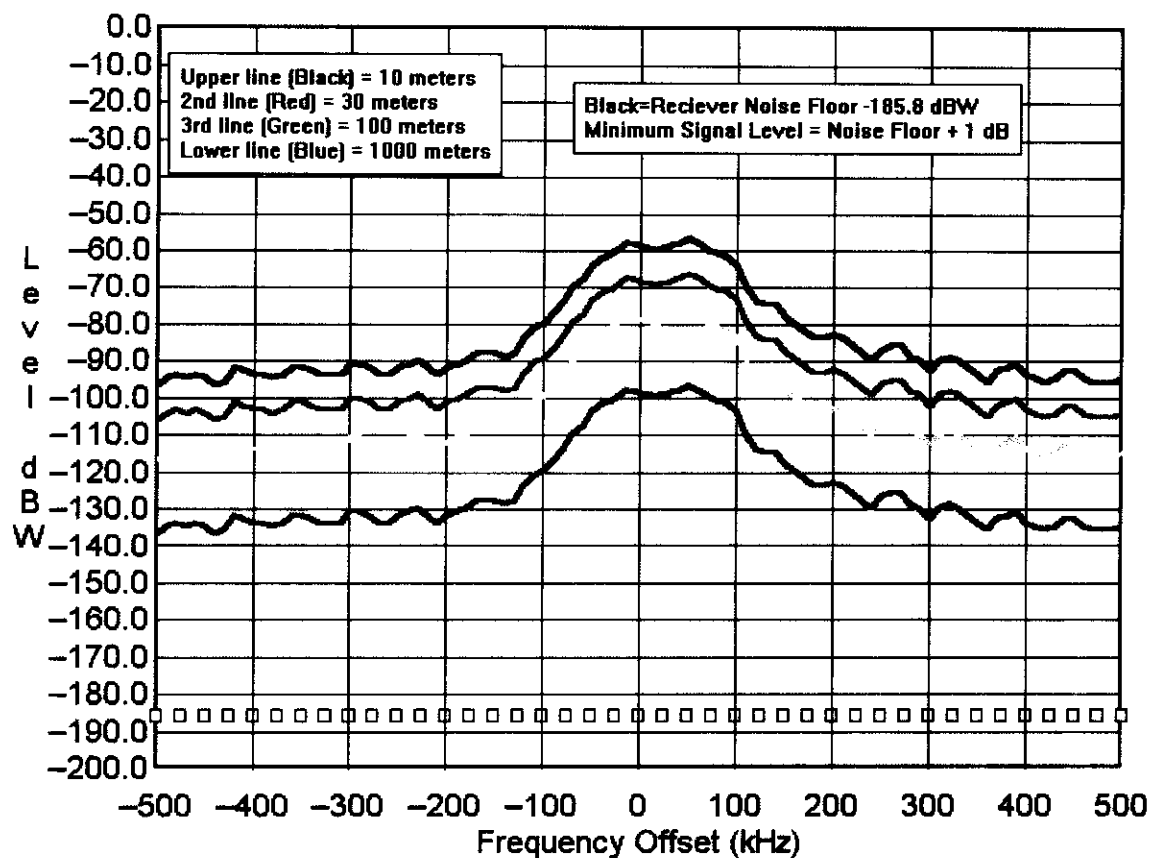


Figure 11. These data show the expected RFID system levels from the typical RFID transmitter generating 110,000 $\mu\text{V/m}$ at 3 meters. The amateur station is a CW terrestrial receiving station using a 17.9-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 110,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 24.8 dB to account for the receive system bandwidth of 0.1 kHz. This amateur station typically has about -185.8 dBW of receiver sensitivity and a signal margin of approximately 1 dB for minimal communication.

Typical 70 cm EME Amateur Station

The typical EME model is capable of CW communication with any EME station.

Characteristics	Values	
Frequency Band (MHz)	420-450	
Channel Spacing	Random	
Information Rate	CW: 10 bit/s	
Emission Type(s)	50H0A1A	
Transmitter Power (dBW)	30	
Transmission Line Loss (dB)	Transmit: 1	Receive: 0
Antenna Polarization	H	
Antenna Maximum Gain (dBi)	26	
Maximum e.i.r.p. (dBW)	55	
Receiver IF Bandwidth	CW: 50 Hz	
Receiver Noise Figure (dB)	0.3	
Receiver Thermal Noise (dBW)	-195.5	
Receiver Thermal Noise (dBm)	-165.5	
Receiver Signal-to-Noise Ratio (dB)	+1	
Availability Target %	99 (when moon is in view)	
Maximum Path Length (km)	396,000 one way to moon at nominal apogee	

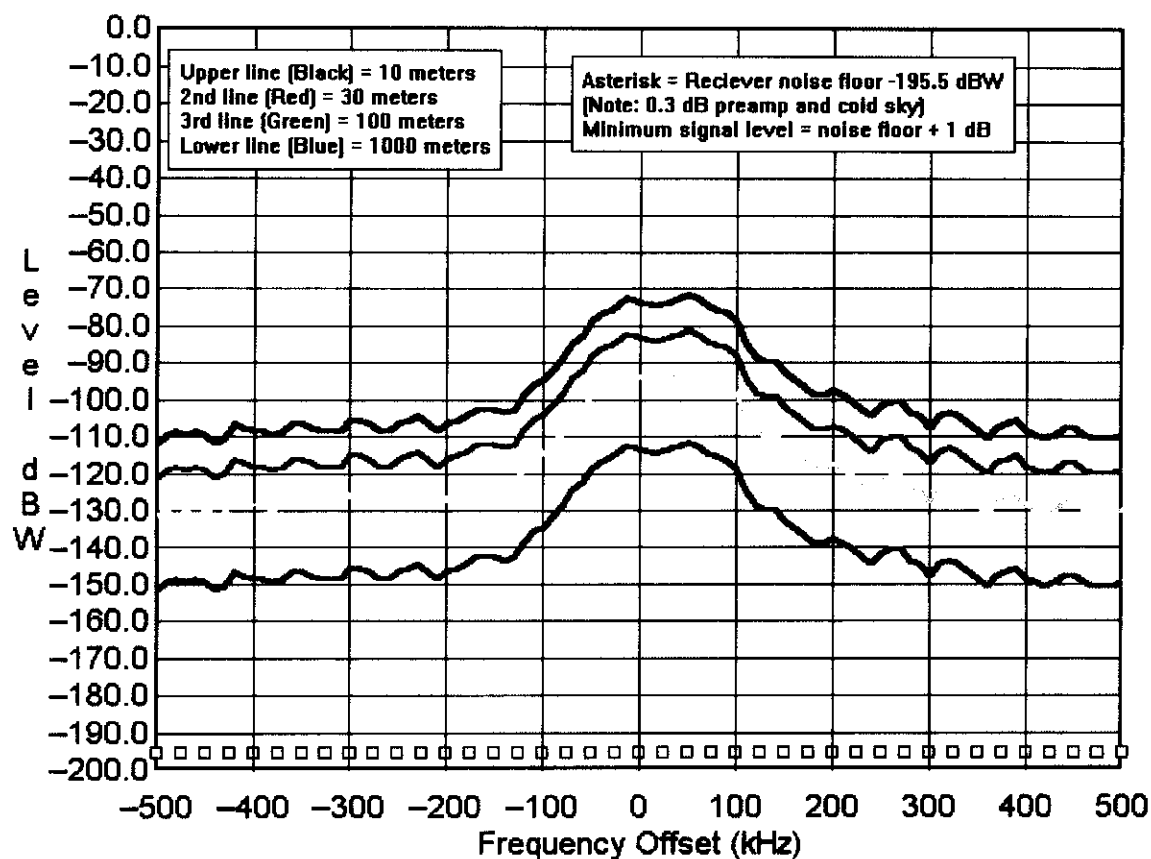


Figure 12. These data show the expected RFID system levels from the typical RFID transmitter generating 11,000 $\mu\text{V/m}$ at 3 meters. The amateur station is a CW earth-moon-earth (EME) terrestrial receiving station using a 26.0-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 11,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 27.8 dB to account for the receive system bandwidth of 0.05 kHz. This amateur station typically has about -195.5 dBW of receiver sensitivity (0.3 dB NF preamplifier and a cold sky target) and a signal margin of approximately 1 dB for minimal communication.

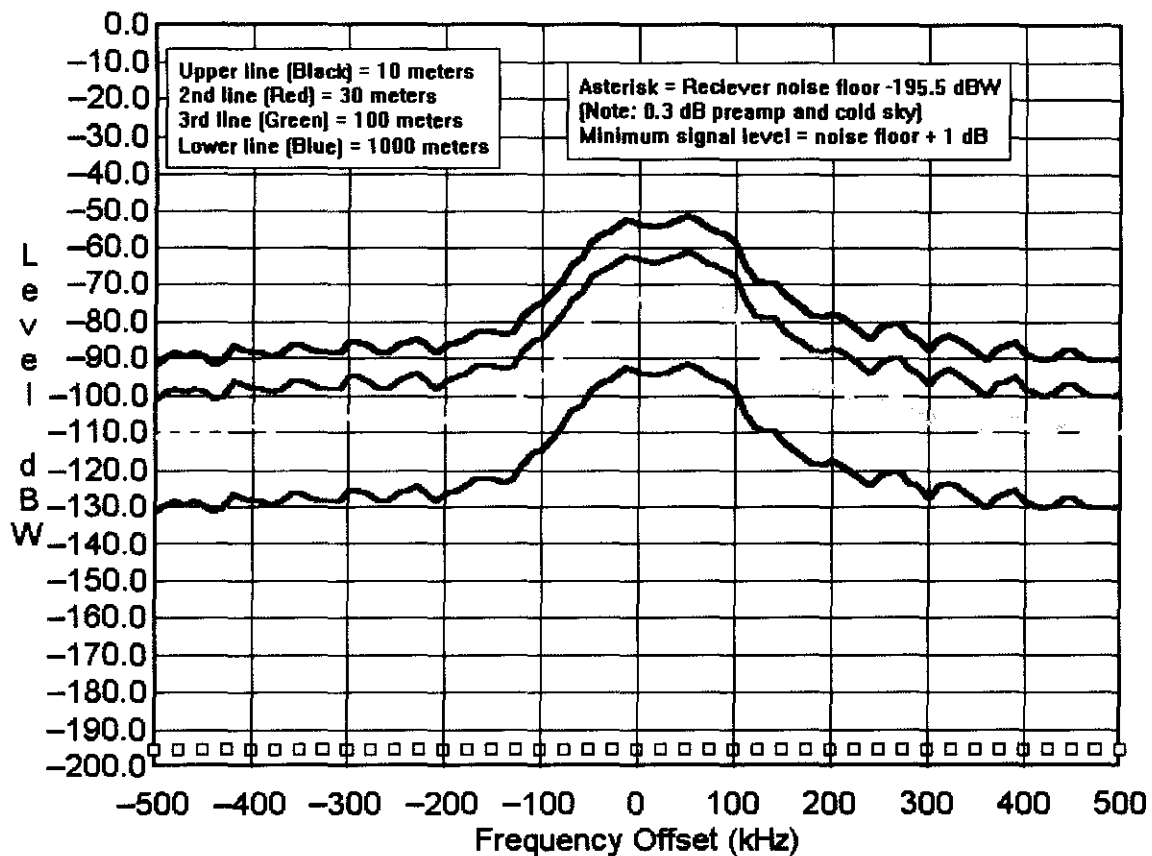


Figure 12. These data show the expected RFID system levels from the typical RFID transmitter generating 110,000 $\mu\text{V/m}$ at 3 meters. The amateur station is a CW earth-moon-earth (EME) terrestrial receiving station using a 26.0-dBi gain antenna. The antenna is located at a distance of 10 meters, 30 meters, 100 meters and 1000 meters from the point at which the field is 110,000 $\mu\text{V/m}$. The predicted levels from the RFID transmitter have been adjusted downward by 27.8 dB to account for the receive system bandwidth of 0.05 kHz. This amateur station typically has about -195.5 dBW of receiver sensitivity (0.3 dB NF preamplifier and a cold sky target) and a signal margin of approximately 1 dB for minimal communication.